SIYATHEMBA SUBSTATIONS:
Wetland Assessment

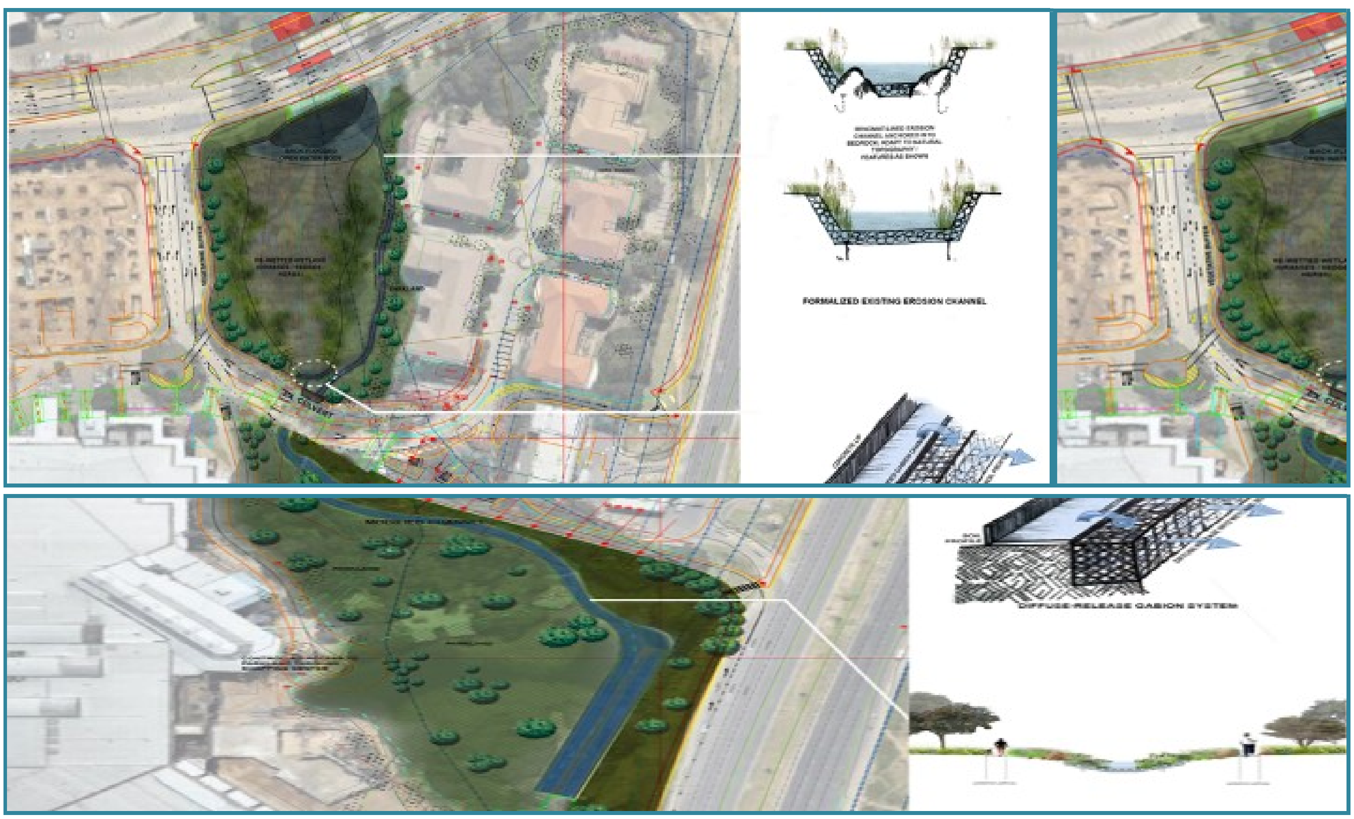
Prepared for:

NSOVO Environmental Consulting

40 Lyncon Road
Carlswald
Midrand
1684

Prepared by:

Willem Lubbe
trading as
WaterMakers



May 2018

Declaration of Independence

I, **Willem Lubbe,** in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Have and will not have vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement; and
- Undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered.

Willem Lubbe *Cert. Sci. Nat.*
Wetland Specialist
SACNASP Reg. No. 100064/08

May 2018
Date

EXECUTIVE SUMMARY

NSOVO Environmental Consultants has been appointed by Dipaleseng Local Municipality which proposes the development of 20MVA 88/22kV Siyathemba substation and associated infrastructure in order to meet electricity demand in the area. WaterMakers, as independent ecological specialists were appointed by NSOVO to conduct a wetland assessment for the proposed application processes. The terms of reference for the current study were as follow:

- Delineate wetlands and riparian habitat within the two study areas;
- Corroborate field and desktop data and classify confirmed wetlands into hydrogeomorphic units;
- Determine the functionality of wetlands within the study areas, using a Level 2 Wet-EcoServices (Kotze *et al.*, 2005) assessment;
- Determine the Present Ecological Status (PES) of identified wetlands within the study areas through applying a Level 2 Wet-Health assessment (Macfarlane *et al.*, 2008);
- Determine the Ecological Importance and Sensitivity (EIS) of identified wetlands;
- Determine and ground truth the Freshwater Ecosystem Priority Area status of any wetlands on site.
- Delineate wetlands within 500m from the study area at desktop level;
- Determine the functionality of wetlands within 500m from study area, using a Level 1 Wet-EcoServices (Kotze *et al.*, 2005) assessment;
- Determine the Present Ecological Status (PES) of wetlands within 500m from the study area through applying a Level 1 Wet-Health assessment (Macfarlane *et al.*, 2008);
- Determine the Ecological Importance and Sensitivity (EIS) of identified wetlands within 500m from the study area; and
- Complete DWS Risk assessment matrix in order to gauge potential impact on wetlands located within 500m from the study area

No wetland indicators and or wetland nor riparian habitat were present within either of the two substation study areas or within a 170m radius thereof.

Although no wetlands were identified within the immediate vicinity of the two study areas, one HGM type, a hillslope seepage connected to a watercourse was delineated at desktop level within 500m from the study areas. The hillslope seepage complex was found to potentially perform functions through the provision of various ecosystem services such as streamflow regulation, nitrogen removal, phosphate and sediment

trapping. However, ecosystem services provided by the hillslope seepage wetland has been impacted through current and historic anthropogenic activities.

A Wet-Health level 1 assessment of the wetland located within 500m from the study area were utilised to assign Present Ecological Status scores for the hillslope seepage hydrology, geomorphology and vegetation. Combined area weighted Wet-Health results indicated that wetlands within 500m from the study area have been moderately altered as a result of changes in water inputs (derived from its catchment) and water retention and distribution patterns within the wetland unit itself, as well as vegetation changes due to domestic and rural activities, agricultural practices, infrastructure developments and the presence of alien vegetation species.

The Ecological Importance and Sensitivity assessment was undertaken to rank water resources in terms of:

- Provision of goods and service or valuable ecosystem functions which benefit people;
- Biodiversity support and ecological value; and
- Reliance of subsistence users (especially basic human needs uses);

The majority of the hillslope seepage complex was assigned a medium Ecological Importance and Sensitivity as well as having a moderate Hydrological and Functional Importance. Direct human benefits were associated with water abstraction, the cultivation of crops and grazing within the wetland complex.

Several impacts, including surface water pollution (including sedimentation) and increase run-off were considered during the impact assessment on watercourses situated within 500m from the proposed substations. However, all of the impacts considered during the construction and operational phases were assessed to have no to extremely low potential of having any impacts on the watercourses situated within 500m from the study area as a result of the following factors:

- The size and type of development and expected impacts likely to occur;
- The distance of watercourses from the respective substation sites, minimum 170m;
- The surface topography and slope of the catchment between the proposed substations and the watercourses; and
- The current land use, vegetation and average surface roughness of the terrain in the vicinity of the substations and the watercourses.

The DWS Risk Assessment Matrix, in terms of GA 509, calculated the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the freshwater resources assessed that is situated within 500m from the proposed substation. By assessing the severity, spatial scale, duration and frequency of the proposed infrastructure development, the risk to the potentially affected resource quality was determined to be very low for all aspects during the construction and operational phases and therefore no specific mitigation measures for freshwater resources are considered necessary for this particular project.

From a freshwater resource perspective, either of the two proposed substations could be utilised as the preferred option as a result of the very low risk perceived to be associated with the proposed development. Several general mitigation measures are recommended.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PHOTOGRAPHS

1. INTRODUCTION

With South Africa being a contracting party to the Ramsar Convention on Wetlands, the South African government has taken a keen interest in the conservation, sustainable utilisation and rehabilitation of wetlands in South Africa. This aspect is also reflected in various pieces of legislation controlling development in and around wetlands and other water resources, of which the most prominent may be the National Water Act, Act 36 of 1998. As South Africa is an arid country, with a mean annual rainfall of only 450mm in relation to the world average of 860mm (DWAF, 2003), water resources and the protection thereof becomes critical to ensure their sustainable utilisation. Wetlands perform various important functions related to water quality, flood attenuation, stream flow augmentation, erosion control, biodiversity, harvesting of natural resources, and others, highlighting their importance as an irreplaceable habitat type. Determining the location and extend of existing wetlands, as well as evaluating the full scope of their ecosystem services, form an essential part in striving towards sustainable development and protection of water resources.

1.1 Project Description

NSOVO Environmental Consultants has been appointed by Dipaleseng Local Municipality which proposes the development of 20MVA 88/22kV Siyathemba substation and associated infrastructure in order to meet electricity demand in the area. A key driver towards a successful Basic Assessment (BA) process is the thorough identification and investigation of feasible alternatives. The selection of potential alternatives will be informed by input received from the I&APs, authorities as well as the EAP. Alternatives will be considered and discussed in terms of their practicality and feasibility. It is important to note that the definition of alternatives includes all aspects of the proposed activity including, activity alternatives, process alternatives, scheduling alternatives, demand alternatives; design alternatives and the No-go alternative. Two substation alternatives were considered for the proposed project.

1.2 Terms of Reference

The terms of reference for the current study were as follows:

- Delineate wetlands and riparian habitat within the two study areas;
- Corroborate field and desktop data and classify confirmed wetlands into hydrogeomorphic units;
- Determine the functionality of wetlands, using a Level 2 Wet-EcoServices (Kotze *et al.*, 2005) assessment;
- Determine the Present Ecological Status (PES) of identified wetlands through applying a Level 2 Wet-Health assessment (Macfarlane *et al.*, 2008);

- Determine the Ecological Importance and Sensitivity (EIS) of identified wetlands;
- Determine and ground truth the Freshwater Ecosystem Priority Area status of any wetlands on site.
- Delineate wetlands within 500m from the study area at desktop level;
- Determine the functionality of wetlands within 500m from study area, using a Level 1 Wet-EcoServices (Kotze *et al.*, 2005) assessment;
- Determine the Present Ecological Status (PES) of wetlands within 500m from the study area through applying a Level 1 Wet-Health assessment (Macfarlane *et al.*, 2008);
- Determine the Ecological Importance and Sensitivity (EIS) of identified wetlands within 500m from the study area; and
- Complete DWS Risk assessment matrix in order to gauge potential impact on wetlands located within 500m from the study area

1.3 Assumptions and Limitations

The following limitations were identified during the present study:

- In order to obtain definitive data regarding the biodiversity, hydrology and functioning of particular wetlands, studies should ideally be conducted over a number of seasons and over a number of years. The current study relied on information gained during a one-day field survey conducted during a single season, desktop information for the area as well as professional judgment and experience;
- Wetland and riparian areas within transformed landscapes, such as urban, agricultural settings, or mining areas with existing infrastructure, are often affected by disturbances that restrict the use of available wetland indicators, such as hydrophytic vegetation or soil indicators (e.g. as a result of dense stands of alien vegetation, dumping, sedimentation, infrastructure encroachment and infilling). Hence, a wide range of available indicators are considered, to help determine wetland and riparian boundaries more accurately.
- Wetland and riparian assessments are based on a selection of available techniques that have been developed through the Department of Water Affairs. These methods are, however, largely qualitative in nature with associated limitations due to the range of interdisciplinary aspects that have to be taken into consideration. Although limited, current and historic anthropogenic disturbance within and surrounding the study area has resulted in soil profile disturbances as well as successional changes in species composition in relation to its original /expected benchmark condition; and
- Delineations of wetland areas were largely dependent on the extrapolation of field indicator data obtained during field surveys, 5m contour data for the study

area, and from interpretation of geo-referenced orthophotos and saltelite imagery as well as historic aerial imagery data sets received from Mowbray. As such, inherent ortho-rectification errors associated with data capture and transfer to electronic format are likely to decrease the accuracy of wetland boundaries in many instances.

1.4 Methodology

A one day field survey was undertaken on the 6th of May 2018. The wetland delineation was based on the legislatively required methodology as described by DWAF (2005). Functional assessments of the hydrogeomorphic units outside and within 500m from the study areas were carried out using the Level 1 Wet-EcoServices assessment (Kotze *et al*., 2005). In order to gauge the Present Ecological Status (PES) of wetlands outside the study areas, a Level 1 Wet-Health assessment (Macfarlane *et al*., 2008) was applied in order to assign PES categories to wetlands. For a more comprehensive study approach and specific methodologies employed during the current study, see Appendix A.

2. BACKGROUND INFORMATION

2.1 Locality

The study area is located directly south off Stuard st. in Balfourd, Mpumalanga.. The north western corner co-ordinates for each of the substation sites are 26°40'2.76"S; 28°36'54.99"E and 26°39'59.60"S; 28°36'45.55"E (Figure 1).

2.2 Biophysical description

Climate

Balfour normally receives about 568mm of rain per year, with most rainfall occuring during summer. The chart below (lower left) shows the average rainfall values for Balfour per month. It receives the lowest rainfall (0mm) in July and the highest (107mm) in January. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Balfour range from 16.2°C in June to 26°C in January. The region is the coldest during June when the mercury drops to 0.1°C on average during the night (SA Explorer, 2018).

Regional Vegetation

The study area falls within the Grassland Biome (Rutherford & Westfall, 1994) which is characterized by high summer rainfall and dry winters. Frequent frost during the winter nights as well as marked diurnal temperature variations is unfavourable for tree growth resulting in the Grassland Biome consisting mainly of grasses and plants with perennial underground storage organs, such as bulbs and tubers. A large number of Rare and Threatened plant species in the summer rainfall regions of South Africa is restricted to high-rainfall grassland, making this the vegetation type in most urgent need of conservation.

Frost, fire and grazing within grasslands maintain the herbaceous grass and forb layer and prevent the establishment of thickets (Tainton, 1999). Fire is a natural disturbance caused by lightning, and natural fires (or controlled burning every 3 years or so) is therefore essential for maintaining the structure and biodiversity of this biome. However, if prevented due to activities such as agriculture and mining, thicket forming tree or alien species eventually dominate the natural vegetation and place an additional burden on already scarce resources such as water.

The Grassland Biome is divided into smaller units known as vegetation types. According to Mucina & Rutherford (2006), the study area is situated within the Andesite Mountain Bushveld vegetation type which is restricted to the Gauteng Province from the Johannesburg Dome to Lanseria Airport and Centurion as well as westwards to Muldersdrift and to Tembisa in the east.

According to Mucina & Rutherford (2006), important taxa include the Small Trees: *Acacia caffra* (d), *A. karroo* (d), *Celtis africana*, *Protea caffra*, *Zanthoxylum capense*, *Ziziphus mucronata*. Tall Shrubs: *Asparagus laricinus* (d), *Euclea crispa* subsp. *crispa* (d), *Rhus pyroides* var. *pyroides* (d), *Diospyros lycioides* subsp. *lycioides*, *Gymnosporia polyacantha*, *Lippia javanica*, *Rhamnus prinoides*. Low Shrubs: *Asparagus suaveolens* (d), *Rhus rigida* var. *margaretae*, *Teucrium trifidum*. Soft Shrub: *Isoglossa grantii*. Woody Climber: *Rhoicissus tridentata*. Graminoids: *Eragrostis curvula* (d), *Hyparrhenia hirta* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Cymbopogon pospischilii*, *Digitaria eriantha* subsp. *eriantha*, *Elionurus muticus*, *Eragrostis racemosa*, *E. superba*, *Panicum maximum*. Herbs: *Commelina africana*, *Vernonia galpinii*, *V. oligocephala*. Succulent Herb: *Aloe greatheadii* var. *davyana*.

Conservation status is regarded as Least threatened. Target 24%. About 7% statutorily conserved mainly in the Suikerbosrand Nature Reserve and Magaliesberg Nature Area. An additional 1–2% conserved in other reserves mainly in the Hartbeesthoek Radio Astronomy Observatory. Some 15% already transformed, mainly cultivated and some urban and built-up areas. Some of the unit fringes on major urban areas. Erosion is generally very low (Mucina & Rutherford, 2006).

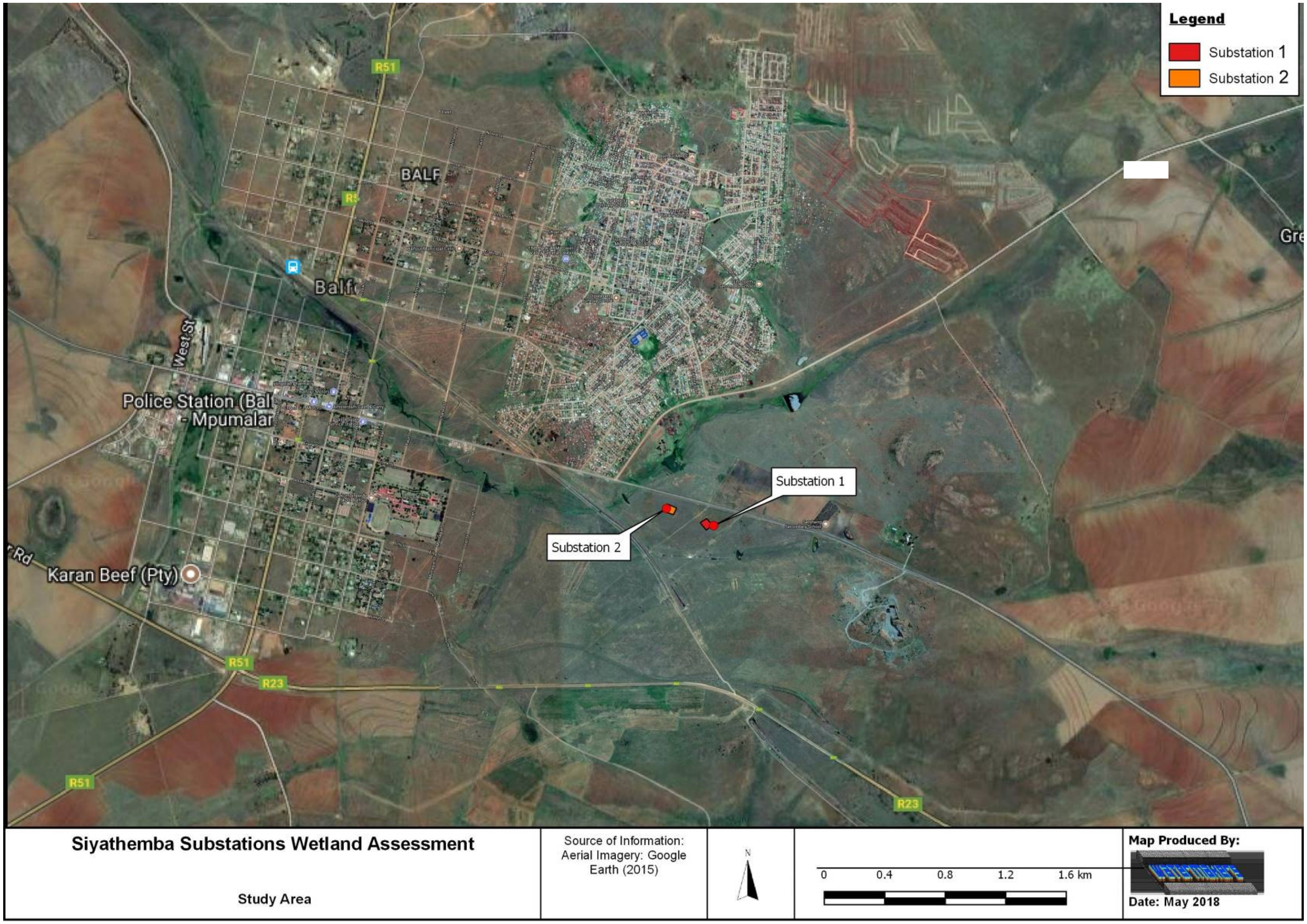


Figure 1: Study areas (Substation 1 and Substation 2)

<u>Geology</u>
According to D.E.M. (1986) the geology underlying the study area is made up of elements from the Klipriviersberg subgroup of the Ventersburg Supergroup (Figure 2). Further, lithology associated with the study area and immediate vicinity consists of Basaltic lava, Agglomerate and Tuff.

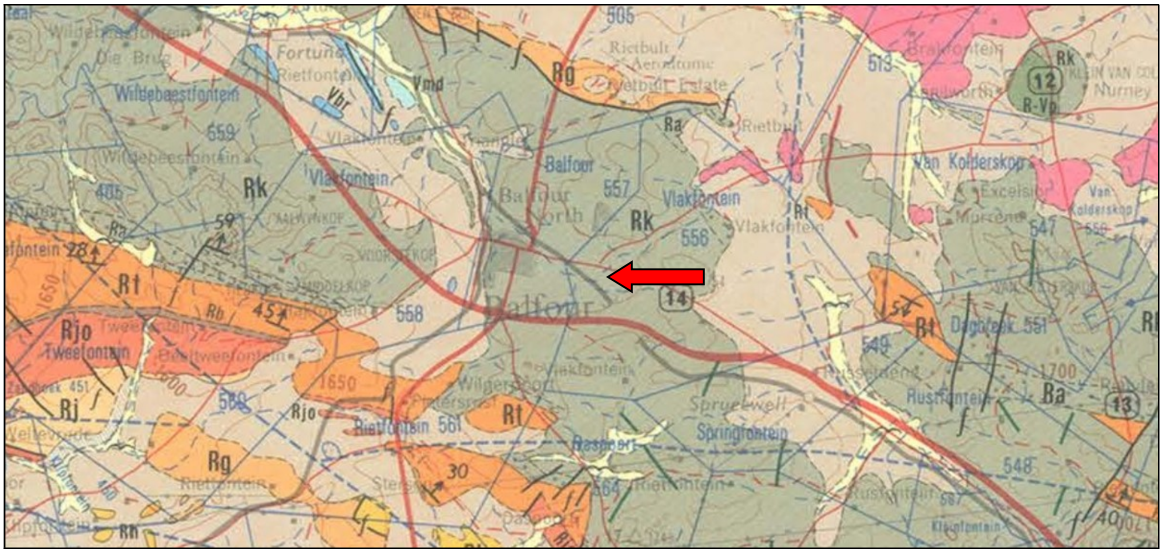


Figure 2: Geology of the study area (2628 East Rand; Department of Mines – Geological Survey). Study area indicated by red arrow

2.3 Wetland Vegetation Group

According to Nel *et al.* (2011), the study area falls within the Central Bushveld Group 1 wetland vegetation group. According to Macfarlane *et al.* (2014), the Central Bushveld Group 1 wetland vegetation group is regarded as being Critically Endangered (Macfarlane *et al.*, 2014).

2.3 Associated Water Courses

The study area is located within the Downstream Vaal Dam Sub-management Area of the Upper-Vaal Water Management Area (WMA), within the quaternary catchment C21B. Water courses in this catchment drain into the Suikerbosrant River downstream before joining the Vaal River.

2.4 National Freshwater Ecosystem Priority Areas Status

The National Freshwater Ecosystem Priority Areas project represents a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African

National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water Affairs (DWA), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). More specifically, the NFEPA project aims to:

- Identify Freshwater Ecosystem Priority Areas (hereafter referred to as 'FEPAs') to meet national biodiversity goals for freshwater ecosystems; and
- Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

The first aim uses systematic biodiversity planning to identify priorities for conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development. The second aim comprises a national and sub-national component: The national component aims to align DWA and DEA policy mechanisms and tools for managing and conserving freshwater ecosystems. The sub-national component aims to use three case study areas to demonstrate how NFEPA products should be implemented to influence land and water resource decision-making processes at a sub-national level. The project further aims to maximize synergies and alignment with other national level initiatives such as the National Biodiversity Assessment (NBA) and the Cross-Sector Policy Objectives for Inland Water Conservation.

Based on current outputs of the NFEPA project, no NFEPA wetland areas or wetland clusters were identified within the study area or within 880m from the study area (Figure 3)

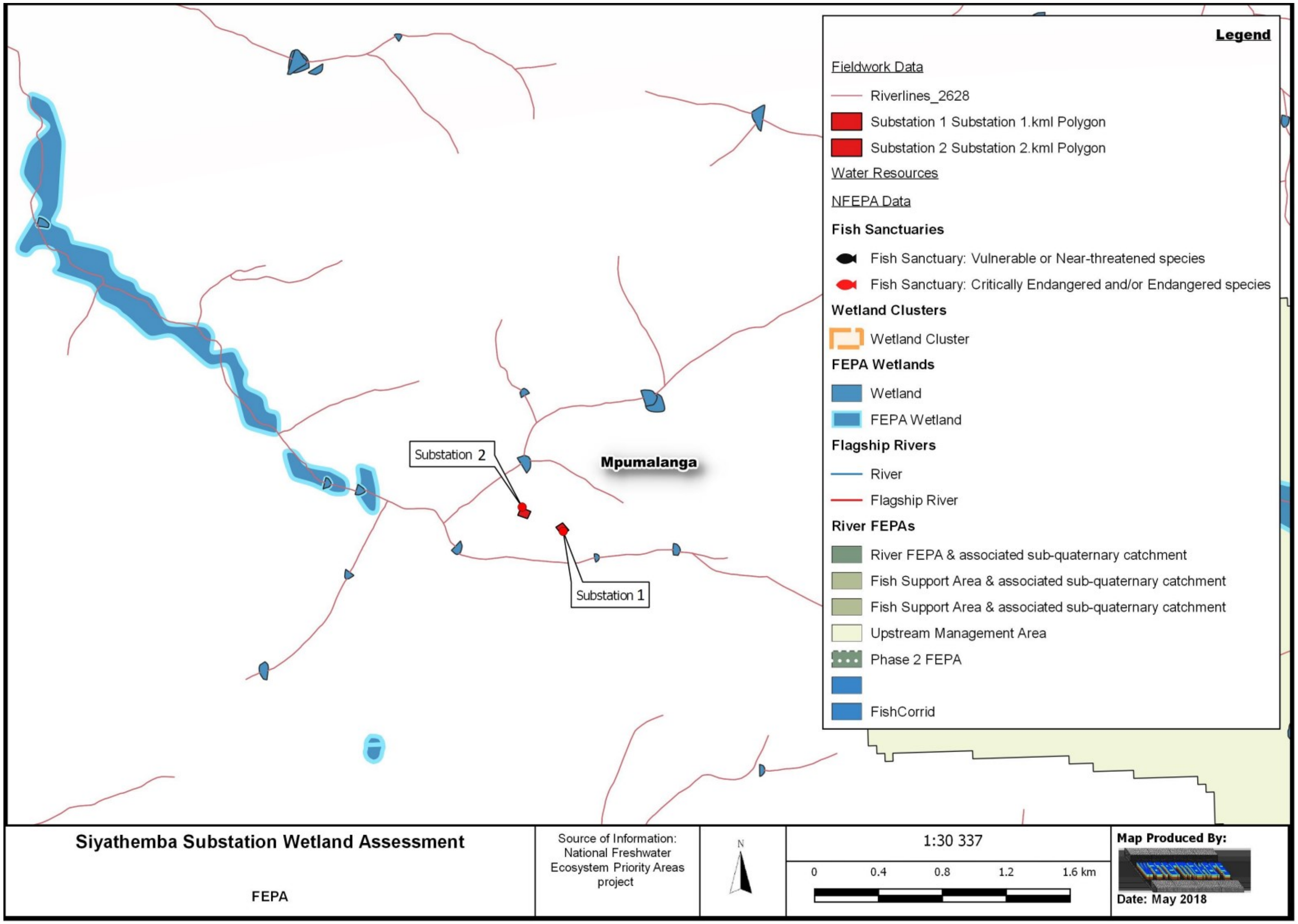


Figure 3: FEPA map of the study area.

3. RESULTS

3.1 Wetland soils

According to DWAF (2005), the permanent zone of a wetland will always have either Champagne, Katspruit, Willowbrook or Rensburg soil forms present, as defined by the Soil Classification Working Group (1991). The seasonal and temporary zones of the wetlands will have one or more of the following soil forms present (signs of wetness incorporated at the form level): Kroonstad, Longlands, Wasbank, Lamotte, Estcourt, Klapmuts, Vilafontes, Kinkelbos, Cartref, Fernwood, Westleigh, Dresden, Avalon, Glencoe, Pinedene, Bainsvlei, Bloemdal, Witfontein, Sepane, Tukulu, Montagu. Alternatively, the seasonal and temporary zones will have one or more of the following soil forms present (signs of wetness incorporated at the family level): Inhoek, Tsitsikamma, Houwhoek, Molopo, Kimberley, Jonkersberg, Groenkop, Etosha, Addo, Brandvlei, Glenrosa, Dundee (DWAF, 2005).

No hydromorphic soils were observed within any of the study areas or within a radius of 170m from the study areas. Soils within the study areas typically consisted of shallow orthic and well-structured soils with numerous rocky areas. Terrestrial soil forms included Mispah, Clovelly and Swartland soil forms (Photograph 1).

Photograph 1: Study areas covered in part by numerous boulders, the Mispah soil form dominated in both study areas

No redoximorphic or any other signs of wetness were observed within either of the two study areas. According to the DWAF (2005), soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence due to the fact that soil wetness indicators remain in wetland soils in most instances, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features within the upper 500mm of the soil profile alone is sufficient to identify the soil as being hydric (a wetland soil), or non-hydric (non-wetland soil) (Collins, 2005).

3.2 Wetland Vegetation

According to DWAF (2005), vegetation is regarded as a key component to be used in the delineation procedure for wetlands. Vegetation also forms a central part of the wetland definition in the National Water Act, Act 36 of 1998. Using vegetation as a primary wetland indicator however, requires undisturbed conditions (DWAF, 2005). A cautionary approach must be taken as vegetation alone cannot be used to delineate a wetland, as several species, while common in wetlands, can occur extensively outside of wetlands. When examining plants within a wetland, a distinction between hydrophilic (vegetation adapted to life in saturated conditions) and upland species must be kept in mind. There is typically a well-defined 'wetness' gradient that occurs from the centre of a wetland to its edge that is characterized by a change in species composition between hydrophilic plants that dominate within the wetland to upland species that dominate on the edges of, and outside of the wetland (DWAF, 2003).

No obligatory wetland or hydrophilic vegetative species were observed within either of the two study areas or within a radius of 170m thereof. Species that dominated within the study areas identified included graminoids such *Eragrostis curvula*, *Hyparrhenia hirta, Themeda triandra, Elionurus muticus*, *Eragrostis racemose and Vernonia oligocephala*. The indigenous invader *Seriphium plumosum* were a characteristic species within localised disturbed areas (Photograph 2).

Photograph 2: Dashed brown line indicates small historic borrow pit with the indigenous invader *Seriphium plumosum* (Bankrupt bush) dominating the vegetative cover in isolated localities

3.3 Delineated Wetland Areas

According to the National Water Act (Act no 36 of 1998) a wetland is defined as, "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*." Wetlands typically occur on the interface between aquatic and terrestrial habitats and therefore display a gradient of wetness – from permanent, to seasonal, to temporary zones of wetness - which is represented in their plant species composition, as well as their soil characteristics. It is important to take cognisance of the fact that not all wetlands have visible surface water.

Hydrophytes and hydric soils are subsequently used as the two main wetland indicators. The presence of these two indicators is symptomatic of an area that has sufficient saturation to classify the area as a wetland. Terrain unit which is another indicator of wetland areas refers to the land unit in which the wetland is found. Wetlands can occur across all terrain units from the crest to valley bottom.

In practice all indicators should be used in any wetland assessment / delineation exercise, the presence of redoximorphic features being most important, with the other indicators being confirmatory. An understanding of the hydrological processes active within the area is also considered important when undertaking a wetland assessment. Indicators should be 'combined' to determine whether an area is a wetland and to delineate the boundary of a wetland. According to the DWAF delineation guidelines, the more wetland indicators that are present the higher the confidence of the delineation. In assessing whether an area is a wetland, the boundary of a wetland or a non- wetland area should be considered to be the point where indicators are no longer present.

No wetland indicators were present within either of the two study areas or within a 170m radius thereof. Therefore no wetland or riparian habitat were delineated within either of the two study areas.

Although no wetlands were identified within the immediate vicinity of the two study areas, one HGM type, a hillslope seepage connected to a watercourse was delineated at desktop level within 500m from the study areas. Several individual hillslope seepages formed a hillslope seepage complex that were clumped together as a result of similarity and to enhance assessment efficiency into one hydro-geomorphic (HGM) unit, HGM 1 (Figure 4). The hillslope seepage complex is connected to a channelled valley bottom wetland just downstream from HGM 1. The distinction and the classification between the valley bottom wetland and the valleyhead seepage wetland (including the hillslope seepage complex) was based on slope as well as the perceived nature of hydrological support feeding the various wetlands. The 1605m contour line were therefore used to separate the valley bottom wetland with an average slope of 0,56% below the 1605m contour line from the hillslope seepage complex which have an average slope of 1,3% above the 1605m contour line (Figure 5). It should further be noticed that the hillslope seepages connections to the valley bottom wetland were intermittently dominated by riparian features as well.

HGM units encompass three key elements (Kotze *et al*, 2005):

(1) Geomorphic setting. This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment);
(2) Water source. There are usually several sources, although their relative contributions will vary amongst wetlands, including precipitation, groundwater flow, stream flow, etc.; and
(3) Hydrodynamics, which refers to how water moves through the wetland.

Table 1 describes the characteristics that form the basis for the classification of the HGM unit downstream of the study area.

Table 1: Wetland hydro-geomorphic types typically supporting inland wetlands in South Africa within 500m from the study area (adapted from Kotze *et al.*, 2005)

Hydro-geomorphic types	Description	Source of water maintaining the wetland[1]	
		Surface	Sub-surface
Hillslope seepage connected to a watercourse 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a stream channel.	*	***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source: * Contribution usually small
*** Contribution usually large
*/ *** Contribution may be small or important depending on the local circumstances

Wetland

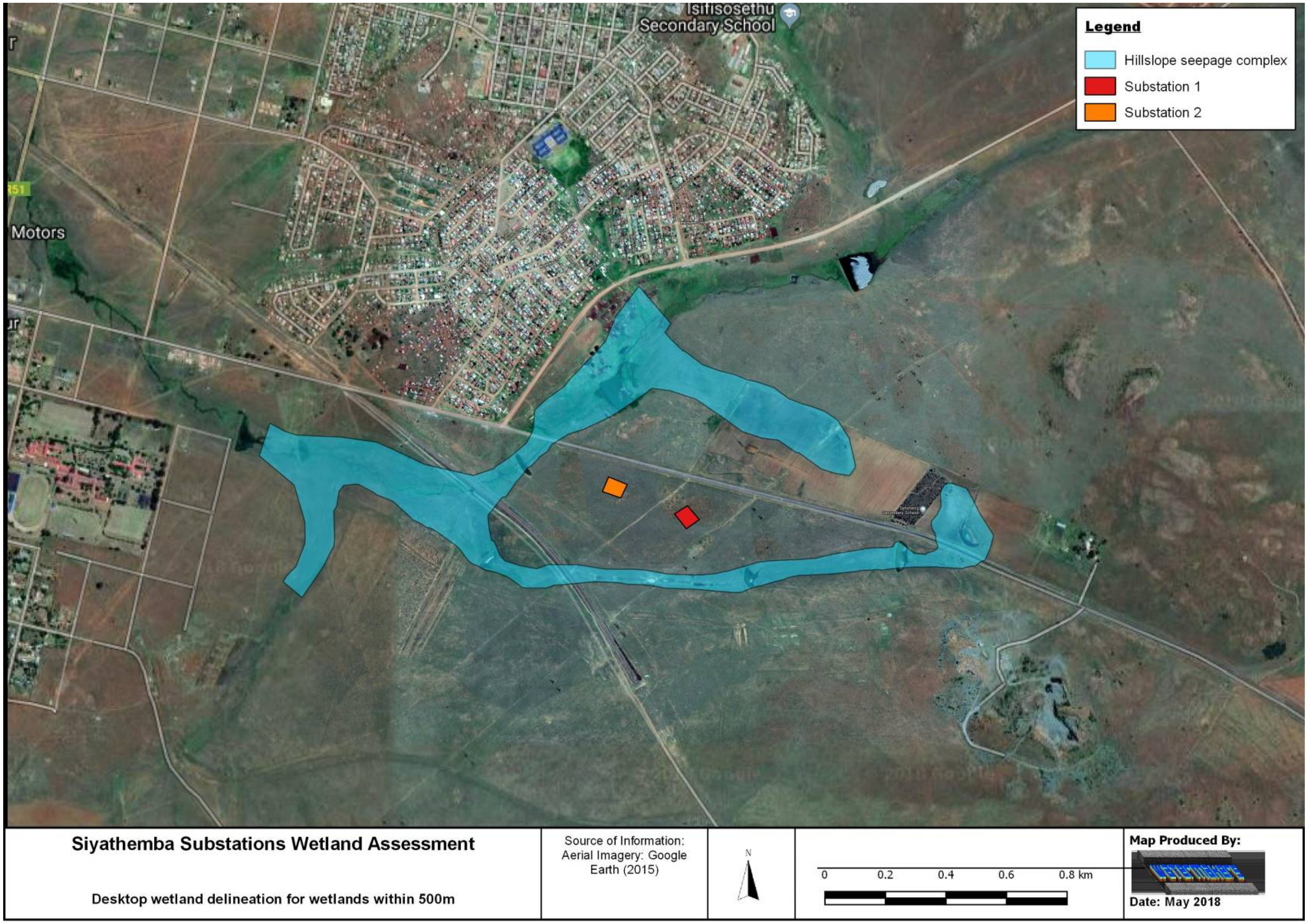


Figure 4: Desktop wetland delineation of wetlands that fall outside of the study areas but within 500m thereof

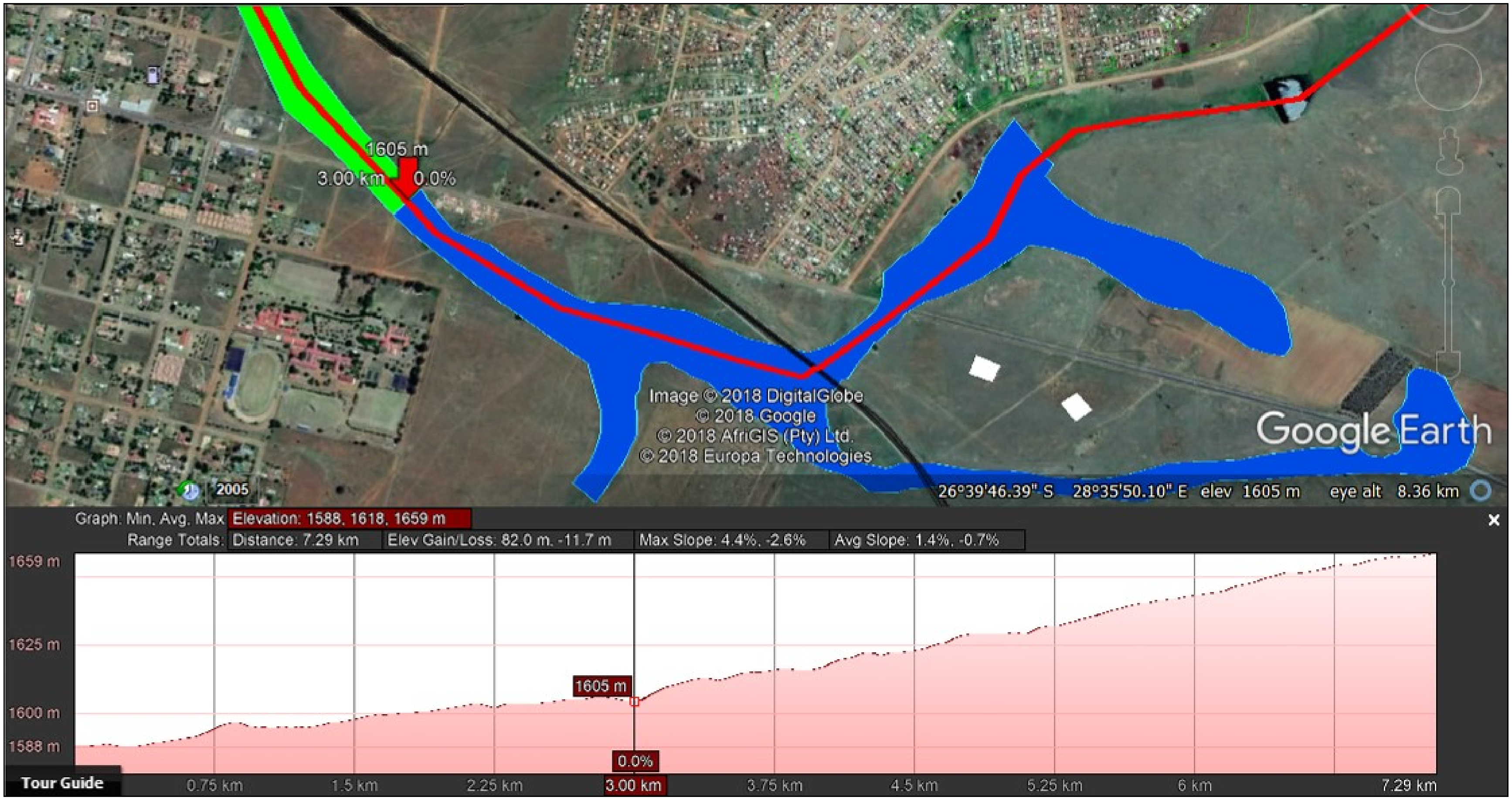


Figure 5: Google Earth Elevation profile of the watercourse with 1605m contour separating the hillslope seepage complex (blue polygon) from the channelled valley bottom wetland (green polygon). The red arrow indicates the start of the valley bottom wetland at the 1605m contour line just downstream from the desktop delineated hillslope seepage complex, HGM 1. The average slope above the 1605m contour line is 1,3% compared to the much lower slope of 0,56% downstream from the 1605m contour line

4. FUNCTIONAL ASSESSMENT

Wetlands within 500m from the study area serve to improve habitat downstream of the study area through the provision of various ecosystem services. Many of these functional benefits therefore contribute directly or indirectly to increase biodiversity through provision and maintenance of appropriate habitat and associated ecological processes (Table 2).

Table 2: Potential wetland services and functions in study area

Function	Aspect
Water balance	Streamflow regulation
	Flood attenuation
	Groundwater recharge
Water purification	Nitrogen removal
	Phosphate removal
	Toxicant removal
	Water quality
Sediment trapping	Particle assimilation
Harvesting of natural resources	Reeds, Hunting, etc.
Livestock usage	Water for livestock
	Grazing for livestock
Crop farming	Irrigation

Hydro-geomorphic units are inherently associated with hydrological characteristics related to their form, structure and particularly their position in the landscape. This, together with the biotic and abiotic character (or biophysical environment) of wetlands, means that these wetlands are able to contribute better to some ecosystem services than to others (Kotze *et al.* 2005) (Table 3).

Table 3: Preliminary rating of the hydrological benefits likely to be provided by a wetland given its particular hydro-geomorphic type (Kotze *et al.*, 2005)

WETLAND HYDRO-GEOMORPHIC TYPE	HYDROLOGICAL BENEFITS POTENTIALLY PROVIDED BY THE WETLAND							
	Flood attenuation		Stream flow regulation	Erosion control	Enhancement of water quality			
	Early wet season	Late wet season			Sediment trapping	Phosphates	Nitrates	Toxicants[2]
Hillslope seepage connected to a watercourse	+	0	+	++	0	0	++	++

[2]Toxicants are taken to include heavy metals and biocides

Rating:
- 0 Benefit unlikely to be provided to any significant extent
- \+ Benefit likely to be present at least to some degree
- ++ Benefit very likely to be present (and often supplied to a high level)

The highest scoring eco-services attributes for the hillslope seepage wetland within 500m from the study area were streamflow regulation, sediment trapping, phosphate trapping and nitrate removal (Figure 5). The accumulation of organic matter and fine sediments in the wetland soils results in the wetland slowing down the sub-surface movement of water down the slope. This "plugging effect" increases the storage capacity of the slope above the wetland, and prolongs the contribution of water to the stream system during low flow periods (Kotze, 2005). Seepage wetlands are commonly considered to supply a number of water quality enhancement benefits, for example, removing excess nutrients and inorganic pollutants produced by agriculture, industry and domestic waste (Rogers *et al*., 1985; Gren, 1995; Ewel, 1997; Postel, 1997). Hillslope seepage wetlands generally would be expected to have a relatively high nitrogen removal potential. Nitrogen, and specifically nitrate removal, could be expected as the groundwater emerges through low redox potential zones within the wetland soils, with the wetland plants contributing to the necessary supply of organic carbon. Particularly effective removal of nitrates has been recorded from diffuse sub-surface flow, as characterizes hillslope seepages (Muscutt *et al*., 1993). Various agricultural, rural, urban and semi-urban activities taking place within the catchment of the seepage wetland would likely act as a source of nitrates and phosphates, including leaking bulk sewage infrastructure

The seepage wetlands are expected to contribute to biodiversity through potentially serving as a movement corridor for faunal species as well as through the provision of habitat. Further, from a natural resource utilisation perspective, seepage wetlands within the study area were evidently utilised for grazing and for planting pasture and crops.

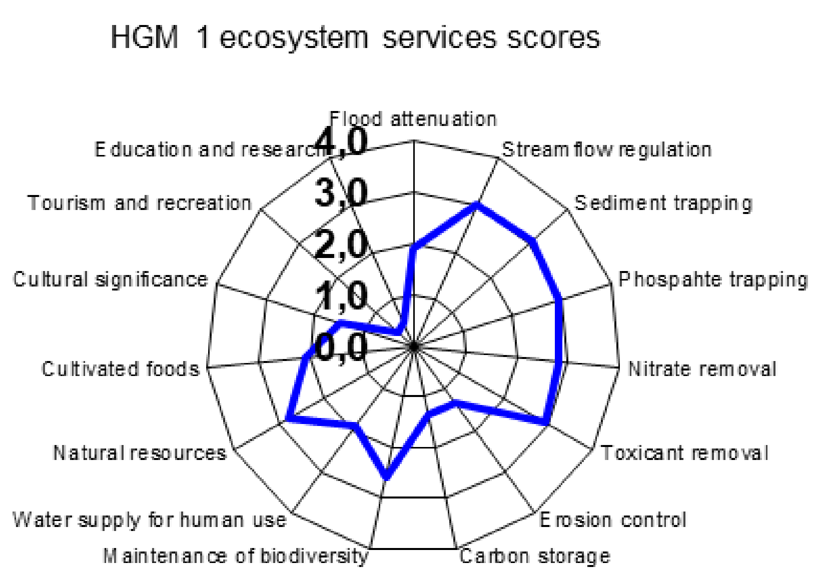


Figure 6: Radar diagram depicting ecosystem services for HGM 1

Each wetland's ability to contribute to ecosystem services within the study area is further dependant on the particular wetland's Present Ecological State (PES) in relation to a benchmark or reference condition. Present Ecological State scores were assigned for the hillslope seepage wetland within the study area using a Wet-Health Level 1 assessment. Through the use of a scoring system, the perceived departure of elements of each particular system from the "natural-state" was determined. The following elements were considered in the assessment:

- Hydrologic: Flow modification (has the flow, rates, volume of run-off or the periodicity changed);
- Geomorphic (Canalisation, impounding, topographic alteration and modification of key drivers);
- Biota (Changes in species composition and richness, Invasive plant encroachment, over utilization of biota and land-use modification)

Degradation of wetlands through impacts in catchments or in wetlands themselves is resulting in the reduction and loss of their functional effectiveness and ability to deliver ecosystem services or benefits to humans and the environment (Kotze *et al.,* 2008). The set relationships allow the provision of ecosystem services to be inferred from the determination of wetland health (PES) and presented as healthy wetland hectare equivalents, Table 4.

Wet-Health results obtained for HGM 1 indicate that the hillslope seepage wetland is moderately modified (PES category C), Table 4.

Table 4: Wet-Health scores for HGM 1

Wetland size (delineated portion)	Hydrology	Geomorphology	Vegetation	PES Category	Healthy hectare equivalent
58,7 ha	3.0	2.4	4.6	**C (3.3)**	39,3 ha

PES scores obtained for the hydrology module indicated that water inputs derived from the wetland's catchment have been modified and that water retention and distribution patterns within the hillslope seepage wetland within the study area have been moderately modified. Changes in flow patterns within the catchment of the wetland include road infrastructure, housing infrastructure, hardened surfaces, excavations as well as reduced basal cover in various segments as a result of heavy grazing regimes as well as agriculture. Distribution and retention patterns of water within the wetland itself has been negatively impacted by road and railway infrastructure as well as through several farm dams and a few dense alien invasive stands.

Vegetation composition changes of the hillslope seepage wetland was a considerable driver of the Present Ecological State category. Due to the nature of historic and current land uses within the catchment, species composition within the wetlands have changed relative to the perceived natural condition or benchmark. This was most evident in areas with historic and or current infrastructure as well as areas utilised for cultivation. Surface roughness within the wetlands have also been reduced as a result of successional changes which caused reduced basal cover in many areas, likely through historic heavy grazing regimes and infrastructure development.

5. ECOLOGICAL IMPORTANCE AND SENSITIVITY

All wetlands, rivers, their flood zones and their riparian areas are protected by law and no development is allowed to negatively impact on rivers and river vegetation. The vegetation in and around rivers and drainage lines play an important role in water catchments, assimilation of phosphates, nitrates and toxins as well as flood attenuation. Quality, quantity and sustainability of water resources are fully dependent on good land management practices within the catchment. All flood lines, riparian zones and wetlands along with corresponding buffer zones must be designated as sensitive.

The Ecological Importance and Sensitivity (EIS) assessment was undertaken to rank water resources in terms of:

- Provision of goods and service or valuable ecosystem functions which benefit people;
- biodiversity support and ecological value; and
- Reliance of subsistence users (especially basic human needs uses).

Water resources which have high values for one or more of these criteria may thus be prioritised and managed with greater care due to their ecological importance (for instance, due to biodiversity support for endangered species), hydrological functional importance (where water resources provide critical functions upon which people may be dependent, such as water quality improvement) or their role in providing direct human benefits (Rountree, 2010).

Ecological Importance and Sensitivity results for the hillslope seepage wetland identified to be associated with the study area are listed in Table 5.

Table 5: Ecological Importance and Sensitivity scores for wetland complexes

Wetland Complex	Parameter	Rating (0 -4)	Confidence (1 – 5)
HGM 1 (Hillslope seepage wetland)	**Ecological Importance & Sensitivity**	**Moderate** (2.0)	3.4
	Hydrological / Functional Importance	**Moderate** (2.3)	2.5
	Direct Human Benefits	**Low** (1.9)	2.5

The majority of HGM 1 were assigned a moderate Ecological Importance and Sensitivity as a result of some perceived degradation of the wetland complex. However, it should be kept in mind that several species of conservation concern could be present which would increase the Ecological Importance and Sensitivity of HGM 1. The hillslope seepage wetland was regarded as having a moderate Hydrological and Functional Importance due to the potential ecosystem services they provide, especially in terms of water flow regulation, phosphate trapping and nitrate removal. Direct human benefits associated with the wetland included water abstraction as well as the cultivation of crops and grazing within the wetland.

6. IMPACT ASSESSMENT

Potential impacts of the proposed activity on wetlands and riparian areas were assessed according to pre-determined criteria (listed below) to derive their most likely severity without the implementation of mitigation/management measures (WOMM). The most practical and necessary mitigation measures were then listed, and the impact severities re-evaluated, assuming that the proposed mitigation/management measures were fully implemented, to see how much the negative impacts could be reduced (WMM). The criteria used are described as follows:

The **NATURE** of an impact refers to a description of the activity, inherent features, characteristics and/or qualities of the impact. Thus, each impact will be comprehensively detailed and contextualised prior to being assessed.

The **EXTENT** refers to the impact footprint. This would imply that if for example a narrow-endemic species were to be lost entirely, then the extent would be global because that species would be lost to the world. If human health is threatened, then the impact is likely to be no more than local and possibly regional.

Table 6: Descriptors and scoring for the EXTENT of an impact

Descriptors	Definitions	Score
Site only	The impact remains within the footprint or cadastral boundary of the site.	1
Local	The impact extends beyond the footprint or cadastral boundary of the site, to include the immediately adjacent and surrounding areas.	2
Regional	The impact includes the greater surrounding area within which the site is located.	3
National	The scale/extent of the impact is applicable to the Republic of South Africa.	4
Global	The scale /extent of the impact is global (i.e. world-wide).	5

The **DURATION** is the period of time for which the impact would be manifest. Importantly, the concept of reversibility is taken into consideration in the scoring. In other words, the longer the impact endures, the less likely is the reversibility of the impact.

Table 7: Descriptors and scoring for the DURATION of an impact

Descriptors	Definitions	Score
Temporary	The impact endures for only a short period of time (0-1 years).	1
Short term	The impact continues to manifest for a period of between 1-5 years.	2
Medium term	The impact continues to manifest for a period of 5-15 years.	3
Long term	The impact will cease after the operational life of the activity.	4
Permanent	The impact will continue indefinitely.	5

The **MAGNITUDE** is the measure of the potential severity of the impact on the associated environment. As with duration, the concept of reversibility should be taken into account when considering the magnitude of the potential impact.

Table 8: Descriptors and scoring for the MAGNITUDE of an impact

Descriptors	Definitions	Score
None	The ecosystem pattern, process and functioning are not affected, although there is a small potential negative impact on quality of the ecosystem, albeit microscopic.	0
Minor	Minor impact - a minor impact on the environment and processes will occur.	2
Low	Low impact - slight impact on ecosystem pattern, process and functioning.	4
Moderate	Valued, important, sensitive or vulnerable systems or communities are negatively affected, but ecosystem pattern, process and functions can continue albeit in a slightly modified way.	6
High	The environment is affected to the extent that the ecosystem pattern, process and functions are altered and may even temporarily cease. Valued, important, sensitive or vulnerable systems or communities are substantially affected.	8
Very High	The environment is affected to the extent that the ecosystem pattern, process and functions are completely destroyed and may permanently cease.	10

PROBABILITY

Table 9: Descriptors and scoring for the PROBABILITY of an impact

Descriptors	Definitions	Score
None	The impact will not occur	**0**
Improbable	Probability very low due to design or experience	1
Low probability	Unlikely to occur	2
Medium probability	Distinct probability that the impact will occur	3
Highly Probable	Most likely to occur	4
Definite	Definite	5

The **SIGNIFICANCE** of impacts will be derived through a synthesis of ratings of all criteria in the following calculation:

(Extent + Duration + Magnitude) x Likelihood = Significance

Table 10: Descriptors for the SIGNIFICANCE score of an impact

Descriptors	Definitions	Score
Low	The perceived impact will not have a noticeable negative influence on the environment and is unlikely to require management intervention that would incur significant cost.	0 – 19
Low to Moderate	The perceived impact is considered acceptable, and application of recommended mitigation measures recommended.	20 – 39
Moderate	The perceived impact is likely to have a negative effect on the receiving ecosystem, and is likely to influence the decision to approve the activity. Implementation of mitigation measures is required, as is routine monitoring to ensure effectiveness of recommended mitigation measures.	40 – 59
Moderate to High	The perceived impact will have a significant impact on the receiving ecosystem, and will likely to have an influence on the decision-making process. Strict implementation of mitigation measures as provided is required, and strict monitoring and high levels of compliance and enforcement in respect of the impact in question are required.	60 – 79
High	The impact on the receiving ecosystem is considered of high significant and likely to be irreversible, and therefore highly likely to result in a fatal flaw for the project. Alternatives to the proposed activity are to be investigated as impact will have an influence on the decision-making process.	80 - 100

Possible impacts and their sources associated with the proposed activities are provided in Table 11 (construction phase) and Table 12 (operational phase). Some of the impacts are relevant during more than one phase and has therefore only been described once under the initial phase.

Table 11: Possible impacts arising during the construction phase

Possible impact	Source of impact
Surface water pollution including sedimentation	Soil disturbances; Flooding of construction area; construction vehicles; construction camp within wetland's catchment, ablution facilities failing; spillages

Table 12: Possible impacts arising during operation phase

Possible impact	Source of impact
Increased erosion	Increased surface runoff where surface and roofs and other hardened surfaces are established and or pipe leakages/bursts occur (if potable water is supplied to the substations)

Impacts considered during the construction phase therefore included hydrocarbons-based fuels or lubricants spilled from construction vehicles, construction materials that are not properly stockpiled, and litter deposited by construction workers may be washed into wetlands and surface water bodies. Stripping of topsoil will result in increased runoff of sediment from site. Should appropriate toilet facilities not be provided for construction workers at the construction crew camps, the potential exists for surface water resources and surrounds to be contaminated by raw sewage.

Impacts considered during the operational phase therefore included increased surface runoff and peak flow discharges that could potentially occur as a result where flat surface such as roofs, access roads and other hardened surfaces are established and or if pipe leakages/bursts occur (if potable water is supplied to the substations)

However, all of the impacts considered during the construction and operational phases were assessed to have no to extremely low potential of having any impacts on the watercourses situated within 500m from the study area as a result of the following factors:

- The size and type of development and expected impacts likely to occur;
- The distance of watercourses from the respective substation sites, minimum 170m;
- The surface topography and slope of the catchment between the proposed substations and the watercourses; and
- The current land use, vegetation and average surface roughness of the terrain in the vicinity of the substations and the watercourses.

The maximum score of significance obtained for potential impacts on watercourses as a result of the development during the construction and operational phases were 2, out of a possible 100, Table 13 and Table 14.

<u>General mitigation measures</u>

- Construction should ideally take place in the winter months as this is the driest period for the region and it would reduce sediment being displaced and transported towards wetlands downslope of the substation;
- The Contractor has a responsibility to inform all staff of the need to be vigilant against any practice that will have a harmful effect on wetlands. This information shall form part of the Environmental Education Programme to be effected by the Contractor, including the following:
    - Any proclaimed weed or alien species that germinates during the contract period shall be cleared by hand before flowering.
    - Unnecessary infilling, excavation, drainage, dumping of building material and hardened surfaces (including buildings and asphalt) should not occur.
    - Imported fill material should be monitored during and after construction for the presence of any alien species. Any such species should be removed immediately.

  - Emergency plans must be in place in case of pollutant spillages into wetland systems or in proximity of the wetland.
  - All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds. It should also only be stored for the minimum amount of time necessary. Stockpiles should be placed upslope off the substation.
  - Erosion control of all banks must take place so as to reduce erosion and sedimentation towards wetland areas.
  - Littering and contamination of water sources during construction must be mitigated by effective construction camp management.
  - All construction materials including fuels and oil should be stored in a demarcated area that is contained within a bunded impermeable surface to avoid spread of any contamination.
  - Cement and plaster should only be mixed within mixing trays. Washing and cleaning of equipment should also be done within a bermed area, in order to trap any cement or plaster and avoid excessive soil erosion. These sites must be rehabilitated prior to commencing the operational phase.
- The site needs to be appropriately cleaned off all refuse, possible contaminants and pollutants left from existing operations;
- A minimum of two rows of sediment curtains need to be installed parallel between the construction site and the downslope environment in order to capture sediment run-off during the construction process;
- Vegetation and soil must be retained in position for as long as possible, and removed immediately ahead of construction / earthworks in the area (DWAF, 2005);
- Runoff from roads must be managed to avoid erosion and pollution problems. Where excessive loose sediment is created, attenuation swales and / or soils screens should be installed;
- Construction vehicles are to be maintained in good working order, to reduce the probability of leakage of fuels and lubricants;
- A walled concrete platform, dedicated store with adequate flooring or bermed area should be used to accommodate chemicals and or hazardous materials such as fuel, cement, bitumen, oil and paint, as appropriate, in well-ventilated areas;
- Sufficient care must be taken when handling these materials to prevent pollution;
- Surface water draining off contaminated areas containing oil and petrol would need to be channelled towards a sump which will separate these chemicals and oils;
- Oil residue shall be treated with oil absorbent such as Drizit or similar and this material removed to an approved waste site;
- Concrete and tar shall only be mixed on mixing trays and in areas which have been specially demarcated for this purpose;
- All concrete and tar that is spilled outside these areas shall be promptly removed by the Contractor and taken to an approved dumpsite;

- After all the concrete / tar mixing is complete all waste concrete / tar shall be removed from the batching area and disposed of at an approved dumpsite;
- Storm water shall not be allowed to flow through the batching area. Cement sediment shall be removed from time to time and disposed of in a manner as instructed by the Consulting Engineer;
- All construction materials liable to spillage are to be stored in appropriate structures with impermeable flooring;
- Portable septic toilets are to be provided and maintained for construction crews. Maintenance must include their removal without sewage spillage;
- Portable septic toilets are to be located outside of the 1:100 year floodline;
- Under no circumstances may ablutions occur outside of the provided facilities;
- No uncontrolled discharges from the construction crew camps to any surface water resources shall be permitted. Any discharge points need to be approved by the relevant authority;
- In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water Affairs (DWA) must be informed immediately;
- Where construction in close proximity to sewer lines is unavoidable, excavations must be done by hand while at all times ensuring that the soil beneath the sewer lines is not destabilised;
- Store all litter carefully so it cannot be washed or blown into any of the water courses within the study area;
- Provide bins for construction workers and staff at appropriate locations, particularly where food is consumed;
- The construction site should be cleaned daily and litter removed;
- Conduct ongoing staff awareness programs so as to reinforce the need to avoid littering; and
- It is recommended that transformers be appropriately bunded in order to be able to contain any spillages derived from failures

Table 13: Wetland Impact Assessment for the construction phase

Corridor alternatives	Corrective measures	Impact rating criteria					Significance
		Nature	Extent	Duration	Magnitude	Probability	
WETLAND IMPACT ASSESSMENT							
Substation option 1	No	Negative	1	1	0	1	**2**
Substation option 2	No	Negative	1	1	0	1	**2**
Mitigation measures: None							

Table 14: Wetland Impact Assessment for the operational phase

Corridor alternatives	Corrective measures	Impact rating criteria					Significance
		Nature	Extent	Duration	Magnitude	Probability	
WETLAND IMPACT ASSESSMENT							
Substation option 1	No	Negative	1	1	0	1	**2**
Substation option 2	No	Negative	1	1	0	1	**2**
Mitigation measures: None							

7. RISK ASSESSMENT

The DWS Risk Assessment Matrix, in terms of GA 509, calculated the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the freshwater resources assessed that is situated within 500m from the proposed substation. These results are summarised in the tables presented below (Table 6). By assessing the severity, spatial scale, duration and frequency of the proposed infrastructure development, the risk to the potentially affected resource quality was determined to be very low for all aspects during the construction and operational phases and therefore no specific mitigation measures for freshwater resources are considered necessary for this particular project.

Table 15: DWS Impact Risk Assessment for wetlands situated within 500m from the proposed substations during the construction and operational phases

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)
NAME and REGISTRATION No of SACNASP Professional member: W Lubbe__________ Reg no.___100064/08_______ NOTE" Final Risk Rating considered by aplying all recommended mitigation measures
Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity														
No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
1	Construction	Establishing Site	Changes to natural topography	Sedimentation, increaed run-off, pollution	1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
			Striping and stockpiling of topsoil		1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
			Digging for linear infrastructure		1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
			Vehicle access to site		1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
			dumping		1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
			Human ablutions		1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
			Leakages from consstruction vechelis		1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
			Increased hardened surface and reduced basal cover		1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
2	Operation	Site utilised as residency	Water leakages	Increased and concentrated flows to watercourse, pollution	1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
			Leaks and spillages from vehicles		1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
			Sewage leakage		1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
			Increased hardened surface and reduced basal cover		1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low Risk
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									#DIV/0!			#DIV/0!			5		5	#DIV/0!	#DIV/0!
3	Decommission	Decommissioning of site	Backfill of material						#DIV/0!			#DIV/0!			5		5	#DIV/0!	#DIV/0!
			Pouring of concrete						#DIV/0!			#DIV/0!			5		5	#DIV/0!	#DIV/0!
			Closure of sump						#DIV/0!			#DIV/0!			5		5	#DIV/0!	#DIV/0!
			Solid waste disposal						#DIV/0!			#DIV/0!			5		5	#DIV/0!	#DIV/0!
			Human ablutions						#DIV/0!			#DIV/0!			5		5	#DIV/0!	#DIV/0!
									#DIV/0!			#DIV/0!			5		5	#DIV/0!	#DIV/0!
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8. CONCLUSION AND RECOMMENDATIONS

No wetland indicators and or wetland nor riparian habitat were present within either of the two study areas or within a 170m radius thereof.

Although no wetlands were identified within the immediate vicinity of the two study areas, one HGM type, a hillslope seepage connected to a watercourse was delineated at desktop level within 500m from the study areas. The hillslope seepage complex was found to potentially perform functions through the provision of various ecosystem services such as streamflow regulation, nitrogen removal, phosphate and sediment trapping. However, ecosystem services provided by the hillslope seepage wetland has been impacted through current and historic anthropogenic activities.

A Wet-Health level 1 assessment of the wetland located within 500m from the study area were utilised to assign Present Ecological Status scores for the hillslope seepage hydrology, geomorphology and vegetation. Combined area weighted Wet-Health results indicated that wetlands within 500m from the study area have been moderately altered as a result of changes in water inputs (derived from its catchment) and water retention and distribution patterns within the wetland unit itself, as well as vegetation changes due to domestic and rural activities, agricultural practices, infrastructure developments and the presence of alien vegetation species.

The Ecological Importance and Sensitivity assessment was undertaken to rank water resources in terms of:

- Provision of goods and service or valuable ecosystem functions which benefit people;
- Biodiversity support and ecological value; and
- Reliance of subsistence users (especially basic human needs uses);

The majority of the hillslope seepage complex was assigned a medium Ecological Importance and Sensitivity as well as having a moderate Hydrological and Functional Importance. Direct human benefits were associated with water abstraction, the cultivation of crops and grazing within the wetland complex.

Several impacts, including surface water pollution (including sedimentation) and increase run-off were considered during the impact assessment on watercourses situated within 500m from the proposed substations. However, all of the impacts considered during the construction and operational phases were assessed to have no to extremely low potential of having any impacts on the watercourses situated within 500m from the study area as a result of the following factors:

- The size and type of development and expected impacts likely to occur;
- The distance of watercourses from the respective substation sites, minimum 170m;
- The surface topography and slope of the catchment between the proposed substations and the watercourses; and

- The current land use, vegetation and average surface roughness of the terrain in the vicinity of the substations and the watercourses.

The DWS Risk Assessment Matrix, in terms of GA 509, calculated the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the freshwater resources assessed that is situated within 500m from the proposed substation. By assessing the severity, spatial scale, duration and frequency of the proposed infrastructure development, the risk to the potentially affected resource quality was determined to be very low for all aspects during the construction and operational phases and therefore no specific mitigation measures for freshwater resources are considered necessary for this particular project.

From a freshwater resource perspective, either of the two proposed substations could be utilised as the preferred option as a result of the very low risk perceived to be associated with the proposed development. Several general mitigation measures are recommended.

9. GLOSSARY

Alien species Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity.

Biodiversity Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Biome A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.

Buffer zone A collar of land that filters edge effects.

Conservation The management of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystems function and integrity.

Critically Endangered A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Ecosystem Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space.

Ecological Corridors Corridors are roadways of natural habitat providing connectivity of various patches of native habitats along or through which faunal species may travel without any obstructions where other solutions are not feasible.

Edge effect Inappropriate influences from surrounding activities, which physically degrade habitat, endanger resident biota and reduce the functional size of remnant fragments including, for example, the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution.

Endangered A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

Exotic species Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity

Fauna The animal life of a region.

Flora The plant life of a region.

Forb	A herbaceous plant other than grasses.
Habitat	Type of environment in which plants and animals live.
Indigenous	Any species of plant, shrub or tree that occurs naturally in South Africa.
Invasive species	Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas.
Outlier	An observation that is numerically distant from the rest of the data
Primary vegetation	Vegetation state before any disturbances such as cultivation, overgrazing or soil removal
Threatened	Species that have naturally small populations, and species which have been reduced to small (often unsustainable) population by man's activities.
Red data	A list of species, fauna and flora that require environmental protection. Based on the IUCN definitions.
Species diversity	A measure of the number and relative abundance of species.
Species richness	The number of species in an area or habitat.
Vulnerable	A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

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APPENDIX A

Wetland delineation methodology

The report incorporated a desktop study, as well as field surveys, with site visits conducted during May 2018. Additional data sources that were incorporated into the investigation for further reliability included:

- Google Earth images;
- 1:50 000 cadastral maps;
- ortho-rectified aerial photographs;
- Historic imagery from Mowbrey; and
- 2m contour map.

A pre-survey wetland delineation was performed in order to assist the field survey. Identified wetland areas during the field survey were marked digitally using GIS (changes in vegetation composition within wetlands as compared to surrounding non-wetland vegetation show up as a different hue on the orthophotos, thus allowing the identification of wetland areas). These potential wetland areas were confirmed or dismissed and delineation lines and boundaries were imposed accordingly after the field surveys.

The wetland delineation was based on the legislatively required methodology as described by DWAF (2005). The DWAF delineation guide (DWAF, 2005) uses four field indicators to confirm the presence of wetlands, namely:

- terrain unit indicator (i.e. an area in the landscape where water is likely to collect and a wetland to be present),
- soil form indicator (i.e. the soils of South Africa have been grouped into classes / forms according to characteristic diagnostic soil horizons and soil structure), See Figure 6 for auger sample points
- soil wetness indicator (i.e. characteristics such as gleying or mottles resulting from prolonged saturation), and
- vegetation indicator (i.e. presence of plants adapted to or tolerant of saturated soils).

The Department of Water affairs and Forestry (DWAF) wetland delineation guide makes use of indirect indicators of prolonged saturation by water, namely wetland plants (hydrophytes) and (hydromorphic) soils. The presence of these two indicators is indicative of an area that has sufficient saturation to classify the area as a wetland. Hydrophytes were recorded during the site visit and hydromorphic soils in the top 0.5 m of the profile were identified by taking cored soil samples with a bucket soil auger and Dutch clay auger (photographs of the soils were taken). Each auger point was marked with a handheld Global Positioning System (GPS) device.

Assessing Functionality

The methodology "Wet-EcoServices" (Kotze et al., 2005) was adapted and used to assess the different benefit values of the wetland units. A level one assessment, including a desktop study and a field assessment were performed to determine the wetland functional benefits between the different hydro-geomorphological types within the study area. Other documents and guidelines used are referenced accordingly. During the field survey, all possible wetlands and drainage lines identified from maps and aerial photos were visited on foot. Where feasible, cross sections were taken to determine the state and boundaries of the wetlands. Following the field survey, the data was submitted to a GIS program for compilation of the map sets. Subsequently the field survey and desktop survey data were combined within a project report.

Assessing Present Ecological State (PES)

In order to gauge the Present Ecological State of various wetlands within the study area, a level 1 Wet-Health assessments was applied in order to assign PES categories to certain wetlands. Wet-Health (Macfarlane et al., 2009) is a tool which guides the rapid assessment of a wetland's environmental condition based on a site visit. This involves scoring a number of attributes connected to the geomorphology, hydrology and vegetation, and devising an overall score which gives a rating of environmental condition.

Wet-Health is useful when making decisions regarding wetland rehabilitation, as it identifies whether the wetland is beyond repair, whether rehabilitation would be beneficial, or whether intervention is unnecessary, as the wetland's functionality is still intact. Through this method, the cause of any wetland degradation is also identified, and this facilitates effective remediation of wetland damage. There is wide scope for the application of Wet-Health as it can also be used in assessing the Present Ecological State of wetlands and thereby assist in determining the Ecological Reserve as laid out under the National Water Act. Wet-Health offers two levels of assessment, one more rapid than the other.

For the assessments, an impact and indicator system is used. The wetland is first categorized into the different hydrogeomorphic (HGM) units and their associated catchments, and these are then assessed individually in terms of their hydrological, geomorphologic and vegetation health by examining the extent, intensity and magnitude of impacts, of activities such as grazing or draining. The extent of the impact is measured by estimating the proportion the wetland that is affected. The intensity of the impact is determined by looking at the amount of alteration that occurs in the wetland due to various activities. The magnitude is then calculated as the combination of the intensity and the extent of the impact and is translated into an impact score. This is rated on a scale of 1 to 10, which can be translated into six health classes (A to F – compatible with the ecostatus categories used by DWAF, Table 16). Threats to the wetland and its overall vulnerability can also be assessed and expressed as a likely Trajectory of Change.

Table 16: Interpretation of scores for determining present ecological status (Kleynhans 1999)

Rating of Present Ecological State Category (PES Category)
CATEGORY A Score: 0-0.9; Unmodified, or approximates natural condition.
CATEGORY B Score: 1-1.9; Largely natural with few modifications, but with some loss of natural habitats.
CATEGORY C Score: 2 – 3.9; Moderately modified, but with some loss of natural habitats.
CATEGORY D Score: 4 – 5.9; Largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
OUTSIDE GENERAL ACCEPTABLE RANGE
CATEGORY E Score: 6 -7.9; Seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
CATEGORY F Score: 8 - 10; Critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

* If any of the attributes are rated <2, then the lowest rating for the attribute should be taken as indicative of the PES category and not the mean

Determination of Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity was determined by utilising a rapid scoring system. The system has been developed to provide a scoring approach for assessing the Ecological, Hydrological Functions; and Direct Human Benefits of importance and sensitivity of wetlands. These scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the NWA, the original Ecological Importance and Sensitivity assessments developed for riverine assessments (DWAF, 1999), and the work conducted by Kotze *et al* (2008) on the assessment of wetland ecological goods and services from the WET-EcoServices tool (Rountree, 2010). An example of the scoring sheet is attached as Table 17. The scores are then placed into a category of very low, low, moderate, high and very high as shown in Table 18.

Table 17: Example of scoring sheet for Ecological Importance and sensitivity

Ecological Importance	Score (0-4)	*Confidence (1-5)*	**Motivation**
Biodiversity support			
Presence of Red Data species			
Populations of unique species			
Migration/breeding/feeding sites			
Landscape scale			
Protection status of the wetland			

Protection status of the vegetation type			
Regional context of the ecological integrity			
Size and rarity of the wetland type/s present			
Diversity of habitat types			
Sensitivity of the wetland	**1.00**		
Sensitivity to changes in floods			
Sensitivity to changes in low flows/dry season			
Sensitivity to changes in water quality			
ECOLOGICAL IMPORTANCE & SENSITIVITY			

Table 18: Category of score for the Ecological Importance and Sensitivity

Rating	Explanation
Very low (0-1)	Rarely sensitive to changes in water quality/hydrological regime.
Low (1-2)	One or a few elements sensitive to changes in water quality/hydrological regime.
Moderate (2-3)	Some elements sensitive to changes in water quality/hydrological regime.
High (3-3.5)	Many elements sensitive to changes in water quality/ hydrological regime.
Very high (+3.5)	Very many elements sensitive to changes in water quality/ hydrological regime.

Risk Assessment

In order for the appropriate authority and Environmental Assessment Practitioner (EAP) to allow for sufficient consideration and understanding of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined below. The first step of the risk/impact assessment is the identification of environmental activities, aspects and impacts. In addition it is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used within the impact assessment are presented below:

- **An activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- **An environmental aspect** is an 'element of an organizations activities,

products and services which can interact with the environment'. The interaction of an aspect with the environment may result in an impact.

- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as freshwater features, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impacts is then assessed by rating each variable numerically according to the defined criteria. The purpose of the rating is to develop a clear understanding of influences and processes associated with each of the impacts. The severity, spatial scope and duration of the impact together comprise the consequence of the impacts and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impacts together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impacts are then read off a significance rating matrix and are used to determine whether mitigation is necessary. The model outcome of the impact was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances, doubt or of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted accordingly.